PARALLEL PROCESSING:

THE NEXT GENERATION OF COMPUTERS

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Parallel Processing Lesson Plan
Grades 8 Duration 2-3 Sessions

WHAT IS PARALLEL PROCESSING?

Parallel Processing refers to the concept of speeding-up the execution of a program by dividing the program into multiple fragments that can execute simultaneously, each on its own processor. A program being executed across *n* processors might execute *n* times faster than it would using a single processor.

WHY PARALLEL PROCESSING WAS DEVELOPED:

In the earliest computers, only one program ran at a time. A computation-intensive program that took one hour to run and a tape-copying program that took one hour to run would take a total of two hours to complete their task. An early form of parallel processing allowed execution of both programs simultaneously. The computer would start an input/output operation, and while it was waiting for the operation to complete, it would execute the processor-intensive program. The total execution time for the two jobs would be a little over an hour.

MAJOR APPLICATIONS OF PARALLEL PROCESSING:

- Supercomputers utilizing parallel processing are used to maintain the safety and reliability of the U.S.'s remaining stockpile of nuclear weapons. Without the nuclear testing, either above or below ground, which was used for research in the past, extremely fine-grained numerical simulation is required to analyze and predict potential problems arriving from long-termed storage of nuclear devices.
- Scientists are using parallel processing to design computer-generated models of vehicles and guardrails to determine the strength and endurance of the guardrails

in the event of a crash. On a single-processing machine, testing one model can take as long as five days. On a parallel machine, the model can be divided into sections, each of which goes to its own processor; a task that normally takes five days can be completed in several hours.

- Airlines use parallel processing to process customer information, forecast demand and decide what fares to charge.
- The medical community uses parallel processing supercomputers to analyze MRI images and study models of bone implant systems.
- Other applications for parallel supercomputer computing are utilized to crack encrypted codes, animated graphics, analysis of geological data, structural analysis, computational fluid dynamics, physics, chemistry, electronic design, and meteorology.

MORE INFORMATION ON PARALLEL PROCESSING

Top 500 Supercomputers

OBJECTIVES

1. The students will demonstrate how processors working in parallel accomplish a designated task faster than a single processor solving the same task by simulating the concept of parallel processing using puzzles.
2. The students will work in cooperative groups to complete the supercomputer simulation.
3. The students will complete the data worksheet indicating the results of the activity.
4. The students will compare, contrast and analyze the results of the activity and draw conclusions.
5. The students will demonstrate an understanding of the vocabulary introduced in the lesson by completing the vocabulary assignment with 90% accuracy.

WORDS YOU WILL LEARN

1. Processor- The part of the computer that controls all of the parts. The processor fetches memory and decodes them to produce signals, which control the other parts of the computer.
2. Supercomputer- A broad term for one of the fastest computers currently available using parallel computing.
3. Parallel Processing- The simultaneous use of more than one computer to solve a problem.
4. Bit- A unit of information; the amount of information obtained by asking the yes or no question; a computational quantity that can take on one of two values, such

as true and false or zero and one; the smallest unit of storage-sufficient to hold one bit.
5. Byte- A collection of 8 bits that can represent up to 256 distinct values.
6. Kilobyte- The equivalent of 1,024 bytes
7. Megabyte- (MB) The equivalent of 1,048,576 bytes
8. Gigabyte- (GB) The equivalent of 1,073,741,824 bytes (This is roughly the amount of data required to encode a human gene sequence!)
9. Terabyte- (TB) The equivalent of 1,099,511,627,776 bytes
10. FLOPS- Floating Points of Operations per Second

MATERIALS

- Five identical one-hundred count jigsaw puzzles (for twenty-one students)
- Pencil/Paper
- Internet accessible computer for additional research
- Colored index cards
- Stopwatch

PROCEDURES

1. Divide the class into five groups. Four of the groups will contain five children and the final group will contain one child.
2. Four groups will receive an identical one-hundred piece puzzle.
3. One group of five students will receive a one-hundred piece puzzle that the instructor has pre-assembled and then carefully segmented into five smaller puzzles. The smaller puzzles will be in zip-loc baggies prior to the activity.
4. Explain to each group that, on the teacher's cue, will be required to complete the puzzle as quickly as possible.
5. The teacher will start the race and time the groups.
6. On the board, the teacher will record the group's time as the task is completed.

DESIRED RESULTS/OBSERVATIONS

The activity is designed to show the puzzle, segmented and isolated (in zip-locs), was easier to assemble in a shorter period of time. The true comparison between single processing, as opposed to parallel processing is depicted in this activity. The group containing one pupil is indicative of a single computer processor attempting to solve a large problem without assistance. The task can be accomplished, but the rate at which the task is completed is time consuming. The group that received the segmented and isolated puzzle accomplished the task in a relatively shorter period of time. This is a good representation of the value of parallel processing; large problems that are segmented and isolated are completed faster.

Parallel Processing Quiz

Name_____
Date_____

Directions: Match the vocabulary words to the definitions.

1._____ a bit of information.	A. terabyte
2._____ Floating points of operation per second.	B.parallel processing
3._____ Collection of 8 bits that can represent up to 256 values.	C. gigabyte
4._____ Part of the computer that controls all of the parts.	D. bit
5._____ The equivalent of 1,099,511,627,776 bytes.	E. kilobyte
6._____ Fastest computers currently available using parallel processing.	F. FLOPS
7._____ The equivalent of 1,024 bytes.	G. megabyte
8._____ Simultaneous use of more than one computer.	H. supercomputer
9._____ The equivalent of 1,073,741,824 bytes.	I. processor
10._____ The equivalent of 1,048,576 bytes.	J. byte

BONUS:

11. Name three applications that utilize parallel processing.

12. What advantages do parallel computers have over single-processing computers?

Parallel Processing Quiz

TEACHER'S ANSWER KEY

Name_____
Date_____

Directions: Match the vocabulary words to the definitions.

1.__D___ A unit of information.

2.__F___Floating points of operation per second.

3.__J__ Collection of 8 bits that can represent up to 256 values.

4.__I___Part of the computer that controls all of the parts.

5.__A__The equivalent of 1,099,511,627,776 bytes.

6.__H_ Fastest computers currently available using parallel processing.

7.__K__ The equivalent of 1,024 bytes.

8.__B___Simultaneous use of more than one computer.

9.__C___The equivalent of 1,073,741,824 bytes.

10.__M_ The equivalent of 1,048,576 bytes.

A. terabyte

B.parallel processing

C. gigabyte

D. bit

E. kilobyte

F. FLOPS

G. megabyte

H. supercomputer

I. processor

J. byte

BONUS:

11. Name three applications that utilize parallel processing. Monitors and maintains nuclear stockpiled weapons; analysis of geological data; code-breaking; computational fluid dynamics…etc. (additional applications see page 1 of lesson plan)
12. What advantage do parallel computers have over single-processing computers?
Speed is the predominant advantage that parallel processors have over single-processing.